

Rhythmical excitation of the heart

The heart is endowed with a specialized electrogenic system for generating rhythmical impulses to cause contraction of the heart muscle and conducting these impulses rapidly throughout the heart .

when this system functions normally ,the atria contract about one sixth of a second ahead of ventricular contraction , which allows filling of ventricles before pumping the blood through the lungs and peripheral circulation .this system is susceptible to damage by heart disease the result is abnormal sequence of contraction of heart chambers .

The excitatory and conductive system of the heart includes : SA node (sinoatrial node) ,internodal pathway,AV node

(atrioventricular node),AV bundle

*SA node : is the normal pacemaker of the heart located in the superior posterior lateral wall of right atrium .

Characteristic of SA node:

The resting membrane potential of SA node fibers is -55or -60 mv, there is natural leakage of SA node to sodium ions causing influx of Na ions so the resting membrane potential increase in positive direction to reach to threshold level which is a bout -40mv and when this occurs, activation of calcium –sodium channels occurs leading to influx of more Na ions and depolarization occurs after that these channels close and channels of K ions open leading to K outflux and repolarization,this occurs again and again because of natural leakage of SA node to Na ions.

SA node fibers make connection with surrounding atrial muscle so the action potential will spread to the atrial muscle and cause excitation of them after that this action potential spread to internodal

pathway.

*internodal pathway : conduct impulses from SA node to AV node.

*AV node :located in the posterior septal wall of right atrium , to transmit impulses from SA node to AV node needs 0.03 sec . AV node make delay in transmitting impulses about 0.09 sec because of presence of few gap junction between the fibers so there is slow transmission of electrical impulses through it .

*AV bundle : it has two parts:

1) penetrating portion of AV bundle

2) distal portion of AV bundle (purkinji fibers)

The penetrating portion is that portion that penetrate the fibrous tissue which separate the atria from ventricles so in this part delay of transmitting of electrical impulses also occurs and is about of 0.04 sec

The distal portion of AV bundle divides in to two branches right and left bundle branches which pass downward in interventricular septum beneath the endocardium toward the apex of the heart then they give many branches that spread along the ventricular champers backward toward the base of the heart also beneath the endocardium and the terminal portion of these fibers penetrate a bout third of ventricular muscle .time of transmitting of the impulses from the distal portion to the terminal portion is about 0.03sec ,it is rapid because of large numbers of gap junctions between the fibers.

SA node is self excited tissue the rate of discharge of this node is 70-80 /minute .

There are also anther self excited tissues like AV node ,purkingi fibers . AV node has rate of discharge of about 40-60 ,purkingi fibers has rate of discharge of a bout 15-40/minute.

SA node is called the normal pacemaker of the heart because it has the highest rate of discharge and it controls the heartbeat .

Anther tissue except SA node controls the heartbeat called actopic pacemaker of the heart .this occurs

*if the rate of discharge of other excitable tissue becomes faster .

*if blockage of transmission of impulses from SA node to other part of the heart occurs and this is abnormal case .

Control of heart rhythmicity and impulse conduction by the cardiac nerves : sympathetic and parasympathetic nerves

The heart is supplied by both sympathetic and parasympathetic nerves the parasympathetic nerves are distributed mainly to SA node and AV node to a lesser extent to the muscle of both atria and very little to the ventricle. the sympathetic nerves distributed to all part of the heart mainly to the ventricles as well as to all other area .

Parasympathetic nerves (vagal) secreate Acetylcoline which increase the cell membrane permeability to K ions so the negativity of the cell membrane so the reaching to the threshold level will be slower that means vagal nerves decrease rate of discharge of SA node or in other way decrease heart rate .

Sympathetic nerves secreate norepinephrine which increase the permeability of cell membrane to Na and Ca ions so the negativity of the membrane decrease and the reaching to the threshold will be faster so it increase the rate of discharge and the heart rate .force of contraction also increase due to increase the permeability to Ca ions.

هذا عمل طلابي قد لا يخلو من الخطأ فالرجاء أعلامنا في حالة وجود خطأ لتصحيحه... ولا تنسونا من صالح الدعاء.

بالتوفيق

